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ABSTRACT

The predictive value of a child abuse screening instrument on unselected populations is illustrated for varying hypothesized levels of child abuse prevalence to demonstrate outcome of a hypothetical national screening program. At any level of application, the prediction of false positives (nonabusing families labeled as abusing or potentially abusing) and false negatives is seen to suggest low practical utility and an unacceptably large social cost. Varying interpretations of the meaning of this possible misclassification are discussed in the context of several program models. The following hypotheses for misclassification are posed: that subjects are really misclassified due to misdiagnosis based on either misinformation or socially induced bias; that subjects only appear misclassified because of limited ability to distinguish between types of cases; and that subjects are misclassified because diagnostic categories are overlapping (i.e. that child abuse is not a distinct category from accidents). Three short case examples demonstrate the implications of these kinds of misclassification for clinical practice program and policy. (Author/SBH)

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Child Abuse Screening: Implications of the Limited Predictive Power of Abuse Discriminants from a Controlled Family Study of Pediatric Social Illness

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The annual number of child abuse and neglect case reports has jumped from fewer than 2000 in 1962 to more than 300,000 in 1975.[1,2] Public and professional concern about this increasingly visible social problem has focussed on the identification and reporting of the victims. In every state, laws oblige the members of virtually every profession in contact with children to report suspected cases.[3] A deluge of reports has not been met with a commensurate increase in amount or quality of services to children and families.[4]

Prevention is now urged as a preferred intervention plan, both for humane reasons and to anticipate fiscal costs and child developmental attrition.[5] Screening for risk of abuse is prominent among the secondary preventive strategies currently being actively pursued. In order efficiently to target scarce intervention resources, predictive indices of risk have been established and applied.[6-9]

The use of screening tests to focus program efforts on a population at high risk is a useful part of the public health approach to many types of disease. In each case the utility of predictive screening must be examined in terms of the prevalence of the condition, the performance of the screening instrument, the effectiveness of available treatments, the costs of various program components, and the nature of alternative approaches to the problem.

Screening Concepts

The performance of a screening instrument is usefully expressed in terms of two probabilities referred to as the "sensitivity" and specificity" of the screening test. Sensitivity is the probability that a "case" will be properly

identified by the screen, i.e., will be "screened positive." Specificity is the probability that a "non-case" will be properly identified, i.e., "screened negative." Obviously a good predictive screen will have both high sensitivity and high specificity.

No screen is perfect, and the harm done by imperfect screening can conveniently be thought of in terms of the costs associated with the two types of predictive error--false positives and false negatives. A false positive is a "non-case" that is predicted to be a case according to the screen. The distinctive costs associated with this type of error arise from the damage done by treating a non-case of child abuse, for example, the removal of a child from the home and the burdening of the alleged victim and his family with all the psychological consequences of this action.

A false negative is a "case" that is not identified by the screen. Here the important cost arises from the failure to provide treatment where it is needed, with resultant additional damage to the child and ultimate higher costs of treatment.

From the above considerations it is clear that these costs are based primarily on the characteristics of the treatment - its effectiveness, and its side effects. Screening is neither inherently good or bad, but is merely a device for the selection of cases into treatment categories with their attendant costs and benefits. Since treatment resources are limited, some form of screening occurs even in the absence of a formal "screening program." Even under non-screening conditions

false positives and false negatives and their associated costs occur.

The impact of all of these considerations is mediated through the prevalance of the disease in the population at which the program is directed. If the condition is very common -- high prevalence -- there may be little need to screen and it may be more effective to simply treat everyone. On the other hand, if the prevalence is low both the screen and the treatment must be of very high quality. Otherwise the costs arising from the dangerous side effects of treating false negatives may become unacceptably high.

Within this range of high to low prevalence, child abuse falls toward the low end of the scale. Alarming as the large amount of violence towards children appears to be from the recent work of Gelles,[10] the currently estimated prevalence of between one and five percent[11,12] is low enough from an epidemiologic point of view to direct particular concern toward the quality of screening instruments and treatment modalities which we might build into preventive programs.

Program Concepts

It will help in understanding the function served by predictive screening if we consider a few basically different ways in which services directed toward the problem of child abuse might be structured. We focus on programs that can be constructed from four basic elements: (1) predictive screening for latent markers of child abuse, (2) reporting of events that constitute manifest markers of the risk of child abuse, (3) preventive treatments that can be applied in the

presence of latent or manifest markers, and (4) treatment of manifest cases of child abuse.

Figure One About Here

At one extreme a program may be based exclusively on the treatment of manifest cases. This is probably still the most common type of program and the one we attempt to improve by coordinating services through team approaches and other related methods. These basic programs service as a useful baseline or reference point against which more extensive preventive approaches may be evaluated. In terms of the present analysis, the primary difficulty with the case-treatment approach is the high cost and low effectiveness of the treatment. By the time cases are recognized too much irremediable damage has been done and the professional and social costs of treatment are high. Nor is there much hard and convincing data which demonstrate the extent to which recidivism is lowered substantially following treatment.[13] This does not, of course, imply that there should be no case treatment or that there should be any diminution of efforts to develop improved methods for dealing with cases as they occur. But the search

for programs that can produce earlier intervention is motivated in no small degree by the sense of theoretical and practical futility which pervades much current child welfare work.

The basic manifest case treatment program is indicated in the first column of Figure 1, where it is designated as Program I. Alternative approaches of increasing complexity appear in the columns to the right and are designated as Programs II, III, and IV. Each successive program design introduces a new element reaching back further in the chain of causation and covering a broader segment of the population. While Program I deals only with manifest cases that come to the attention of society, number II extends the program coverage to children for whom some clear cut event, a behavioral/medical marker, is noted, III encompasses the entire child population which is screened for latent markers of risk prior to the occurance of manifest marker events, and IV provides a broad range of services to all children without specific identification of child abuse markers. Since each stage may be expected to have some failures in identification and coverage of its target group, each program includes the elements of all previous program. Thus each program has at its base the manifest case treatment element in order to cover the failures of preventive treatment. However as one proceeds from I to IV it is to be hoped that the addition of new program elements reduces the need for the elements below it in the column.

Most of the current program effort in child abuse falls in the Program II category. The education of physicians and other

hospital staff members to consider the possibility of abuse in all instances of trauma falls in this category of program where the occurrance of an event is used as a marker of the possible need for preventive treatment. To some extent the mandatory reporting of suspected cases of child abuse is an attempt to extend the recognition of manifest cases to the recognistion of manifest markers. In programs of type II the marker event becomes the admitting device. The various characteristics of the marker events become the screening tool for a range of preventive treatments which may be directed toward the child, the parents, their environment, or the interactions between any of these.

In the type III programs a predictive screening process directed at the entire child population is introduced with the hope of beginning preventive treatment even earlier with less cost and greater effectiveness. Such screens may be sequential in the sense that a rough screen selects children at possible high risk for more refined screening, but they are distinguished from event-reporting programs in that they do not wait for something to happen to the child. Again the sensitivity and specificity of the screen is a matter of great importance in the overall effectiveness of the program particularly if prevalence is low.

Finally programs of type IV begin with the idea of preventive treatment applied to the general population of children as an integral part of the overall structure of services to children and families. As in the other types all previous elements need to be incorporated into a total

program so that any failures from earlier stages will be picked up and handled at later stages. Ideally major emphasis would be placed on, and major success achieved in the earliest stages.

The range of universal services that constitute the first element of programs of type IV may be very broad. They may include the extension of current medical and social services to more complete coverage of the entire population. Or they may include more radical changes in family structure or the economic conditions of society. The governing principle is universal entitlement as a structural ameliorative.

Figure Two About Here

Screening Performance and Prevalence

The interrelationship of the level of prevalence with the performance characteristics of the screening test (sensitivity and specificity) in determining the usefulness of screening is shown in Figure 2. The large square represents 1000 children. The horizontal scale represents the prevalence of the condition. In this figure the prevalence is assumed to be 20% and thus there is a vertical line at 20% prevalence which divides the square into "Cases" on the left, and "Non-Cases" on the right.

The 20% prevalence level is the maximum suggested by Gelles in his recent work on violence within families.[10] It is higher than previous generally accepted estimates and is therefore identified as "High Prevalence." This high level is one that is most likely to make a strong case for screening programs.

The 80% Sensitivity and 90% Specificity used in this figure are considered to define a medium quality of screening test performance. In later charts we shall explore the implications of higher and lower quality of screening.

The vertical scale refers to the proportion of children who are found to be "test-positive" in the screening. The 80% Sensitivity at the left side of the figure indicates that 80% of the "cases" were found to be positive and presumably would be referred for further examination and preventive treatment. These are the 160 "True Positives" out of the 1000 children. The remaining 40 "Cases" in the cross-hatched area at the upper

left are the "False Negatives" i.e., the "cases" missed by screening - one of the two types of error in screening operations.

The second type of screening error is shown in the cross-hatched area at the lower right of the figure. The 90% Specificity divides the 800 "Non-Cases" into 720 "True Negatives" and 80 "False Positives," i.e., eighty non-cases who, because of screening error, are referred for further examination and preventive treatment with all of the accompanying labeling implications.

Under the prevalence and screening test conditions for this figure, a total of 240 children out of every 1000 would be referred from screening as potential cases of child abuse. Two thirds of these would in fact be true cases, but one out of three would not.

Figure Three About Here

Figure 3 is in the same graphic form, but is based upon what we consider to be more nearly realistic, though still somewhat optimal conditions. Here the prevalence is reduced to 10%, and called "Medium" although it is still higher than most previous estimates. The 70% Specificity and 85% Sensitivity are more nearly in line with our previously reported results in constructing discriminant functions to separate abuse from control cases.[14] Under these conditions, given a 10% prevalence, there would be 205 referrals from screening, but now two thirds of the referrals would be erroneous.

Figure Four About Here

In Figure 4 results are shown under an exceedingly optimal set of conditions: 20% Prevalence with 95% Sensitivity and 97.5% Specificity. Even under these favorable circumstances one in ten children referred from screening would have been incorrectly identified.

Table One About Here

It should be further noted that if the prevalence is low, the extent of misclassification is very high even with good sensitivity and specificity. If one assumes a one percent prevalence, as did Light, and a 90% Sensitivity and 95% Specificity, this would lead to an 85% frequency of false positives among all test positives. Unless the negative implications of such labeling can be totally removed we doubt that society will tolerate this kind of cost.

All the previous data is merely hypothetical; an examination of an actual hospital based population also suggests the possibility of an unacceptibly high number of misclassified children. In a case-control study of 560 children under four years of age bearing pediatric social illness diagnoses (child abuse and neglect, accidents, failure to thrive, and poisonings), a group of familial, child developmental, and environmental factors distinguished child abuse families from all the other case and control risk families. One could then examine the non-abuse families for the presence of these risk factors. At the point at which one could correctly identify 75% of the child abuse cases (i.e. 75% specificity) 30% of all other acute illness and trauma patients would also have these risk factors (or in other words only a 70% sensitivity). The ability of researchers in this field to develop high sensitivity and high specificity tests is far from being achieved.

Clinical misclassification

But the issue of missclassification is not just an abstract,

statistical question. The best statistical solution is not necessarily the best clinical solution. Even given evidence for risk from screening or from other encounters, clinical errors and the present taxonomy of pediatric practice have important program and policy implications. These are illustrated in the following three case examples, which illustrate three kinds of clinical misclassification which bear on the screening discussion.

Example One: Subjects are really misclassified due to misdiagnosis based either on misinformation or socially induced bias

A three-week-old baby boy is brought to the hospital Emergency Room by his mother, who is concerned about a large bruise on its left cheek. She says she noticed the bruise, which appeared to be in the shape of fingers, the morning after her husband, a professional medical person, awakened during the night to feed and change the baby, who was crying. The hospital staff sympathized deeply with the family, called the injury an accident, and refused initially to report the case as required by state statute.

On interview with a social worker and psychiatrist, it seemed that the child's father's personality had paranoid features. He associated the birth of his child with a sense of abandonment by his wife. There was concern that he incorporated the child into a delusional system. Interviews supported the formulation that the child's injuries were inflicted.

Debate ensued on whether to report the case. Ultimately, the child advocates on the staff prevailed. No further injuries occurred.

Example Two: Subjects only appear misclassified because of our limited ability to distinguish between types of cases.

A two-year-old girl was brought to the hospital Emergency Room by a child care worker from her day care center. The child, it was said, came to the center frequently with bruises of the arms and legs. Physical examination demonstrated ten small bruises, none of which appeared typical of injuries inflicted by the same instrument, all of which appeared to be in different stages of healing.

The mother arrived at the hospital a half hour later, livid with rage. Who did the center think they were, bringing her child to Children's Hospital for examination without trying to call her first. It was possible to calm everyone down and to conduct a medical interview. The history was benign, but the child was described as a little monster. Her temper tantrums were said to be frequent and designed to get the mother angry; she was extremely active and was described as always running into things; and, yes, she had to be spanked, on the bottom, maybe twice a week.

No specific diagnosis could be assigned to the case. It was not reported as child abuse, and was signed out as an "accident." The mother's need to sort out her feelings toward this little girl was identified and explored

in a supportive way by the hospital social worker. A followup call to the day care center a month later gave the information that the child continued in regular attendance, and that she had fewer and fewer bruises in the weeks following the hospital visit.

Example Three: Subjects are misclassified because diagnostic catagories are overlapping: i.e. that child abuse is not a distinct catagory from accidents.

A one-year-old boy was seen in the hospital Emergency Room for red and blue marks on his back. The interne was unable to elicit a history of trauma, although the marks appeared to be bruises of identical size and age, consistent with blunt trauma. Blood studies excluded hematologic conditions, but the interne noticed that while mother and child were awaiting the lab results, she let him play unattended on a high examining table. At one point, he almost fell off, but a hospital staff member intervened.

His past medical history included several traumatic episodes, each of single organ systems: a fractured skull when he was dropped as a baby, a lacerated nasal bridge when he tumbled forward off the front seat of the car where he was sitting unrestrained at nine months, and a bite on the hand by a neighbors dog.

The diagnosis of child abuse was made, and the case was reported. Subsequent interviews with a protective services social worker disclosed a seeming inability on the mother's part to see the need to protect her boy from

environmental hazards. She also acknowledged a certain fatalism about his many accidents. It was "his time," she said. Candidly she announced one day that indeed she had beaten him; she was, she told the professional who established a relationship with her, concerned that she might lose control again.

With continued involvement by the social worker, the support of a homemaker, and regular health visits, there were no further major traumatic episodes in the second year of the boy's life.

Discussion

Since most child abuse and neglect case reports come from public clinical settings, there is a bias of ascertainment favoring the poor and socially marginal families whose children receive their care from them.[16] For 1975, the National Center on Child Abuse in the Office of Child Development in Washington indicates that there were at least 300,000 reports of child abuse and neglect, and perhaps as many as 600,000 in 1976.[2] Most of these, if past experience is a guide, are of children from families in poverty.[1]

Because of the heavily value-laden nature of the clinical diagnoses 'abuse' and 'neglect,' which implicitly blame the parent for the injuries of a child, there is a negative ascertainment bias for both diagnoses for children in more affluent families, whose parents purchase services from private practitioners reluctant to condemn them. Their injuries are called "accidents," and familial and environmental antecedents and concomitants of acts of God (the causal model implicit in the

name) are largely ignored in present practice, even though survey data now demonstrate a definable prevalence of child abuse and neglect in middle and upper class homes.[10] Physicians and others in private practice adhere to more stringent standards for sharing confidential patient information than do those in public settings, in spite of universal reporting statutes which oblige the contacting of a welfare or police department in cases of child abuse or neglect.[3]

In the case of the three-week-old baby in the professional family, misclassification as an "accident" would have resulted in no protective service action. The family would not have been put on notice of our concern and our legal responsibility. The child would have had a high likelihood of reinjury.

Ironically, it was a social worker from an agency whose stated agenda is to deal with the problems of poor people who helped protect this child in its home. The irony comes from the widespread illusion -- accepted by the professional community and supported by the myriad studies of small samples of impoverished families -- that child abuse and neglect are problems exclusively of the poor. Services for the poor are also often poor; witness the high staff turnover in welfare departments and their chronic organizational chaos and variable standards of professional practice.[4]

In the individual case, misclassification away from child abuse or neglect can mean a lack of protection for the child; but misclassification toward child abuse or neglect may lead to the reflexive separation of a child from its family where local practices are zealously child-saving. The human

costs --and literal costs-- of reinjury or foster home placement are difficult to calculate, but existing studies by Fanschel and others indicate that they are great.[17,18]

The case of the active two-year-old reflects our frequent inability to establish a clinical diagnosis of one or other pediatric social illness. Reporting statutes give wide discretion to professionals in such cases. Depending on the services available in one's jurisdiction, reporting in such instances can be helpful or hurtful. Here, help was given for obvious problems, with good result. The mother did not have to suffer the stigma that we thought she had abused or neglected her child. She was able to protect her child more effectively.

The year-old boy with both accidents and abuse seemed to require a more highly structured program of intervention, including, obviously, a case report to the Welfare Department. To look on his presenting back injuries as continued accidents in an accident-prone child would have been characteristic of much pediatric practice. To do so would have been to ignore the seemingly important contribution of familial factors both to the "accidents" and to the "abuse." The nature of the present diagnostic taxonomy for pediatric social illness obliges for the most part a choice of one diagnosis or other, although there is evidence for overlap in both symptoms and causes of child abuse and neglect, failure to thrive, poisonings, and accidents in early childhood.[14]

Misdiagnosis because of diagnostic overlap, too, is costly. Consider the high morbidity and mortality due to

accidents in children under four.[19] Most of these injuries occur in the home; many might have been prevented were their familial, environmental, and child developmental concomitants -- which presumably affected the protective capacity of these nurturing contexts -- to have been identified in prior incidents. But since, by and large, medical practice is oriented to the treatment of physical symptoms; child development and child care work oriented to the child, not to the parent; and the agencies of the state responsible for major parental failure largely oriented to taking the child from the family, it is difficult to conjure up a coordinated, responsive program for a child with physical symptoms of family crisis. Abraham Maslow put it well when he commented: "If the only tool you have is a hammer, you tend to treat every problem as if it were a nail."

Conclusion

The low prevalence of child abuse combined with even the most optimistic estimates of screening effectiveness implies that any child abuse screening program will yield large numbers of false positives -- non-abusing families labled as abusing or potentially abusing. The large social cost of this type of labeling makes such an approach unacceptable. Consequently we feel that the goal of program development should be toward family and child health activities which address the population as a whole. In clinical practice, too, there should be ever less need for the labeling associated with activities directed toward child abuse and abusers as such. A more nearly adequate, and humane, taxonomy for pediatric social illness would acknowledge

children's injuries as symptoms of complex interactions between a particular child, family, and environment. Better clinical classification and practice would orient professionals from the several disciplines concerned with children's health, development, and welfare toward these causes, rather than simply to predict and protect the victims.

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Figure I

ALTERNATIVE PROGRAM DESIGNS

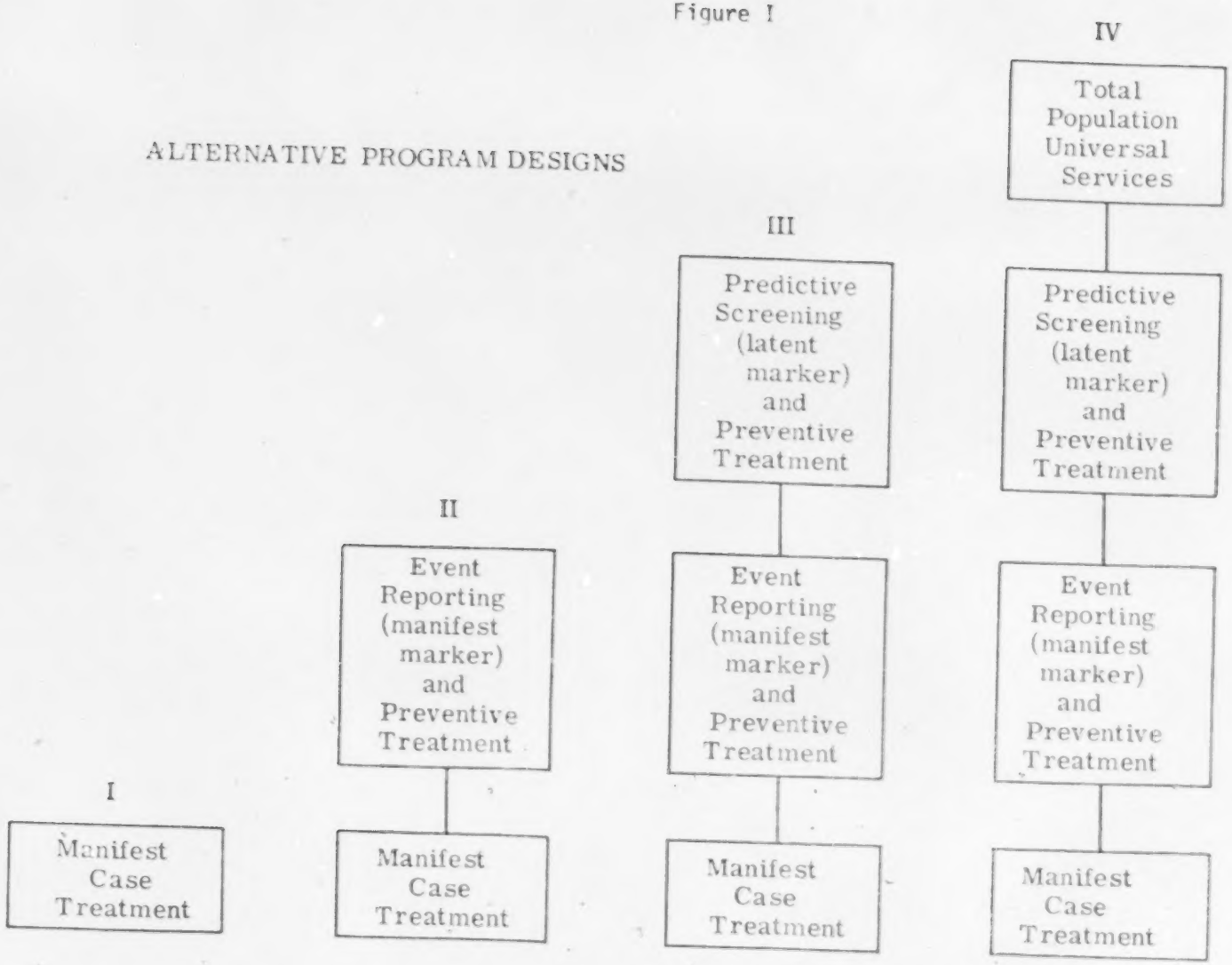

Figure II

SCREENING TEST RESULTS FOR 1000 CHILDREN:
MEDIUM PREVALENCE AND LOW QUALITY SCREEN

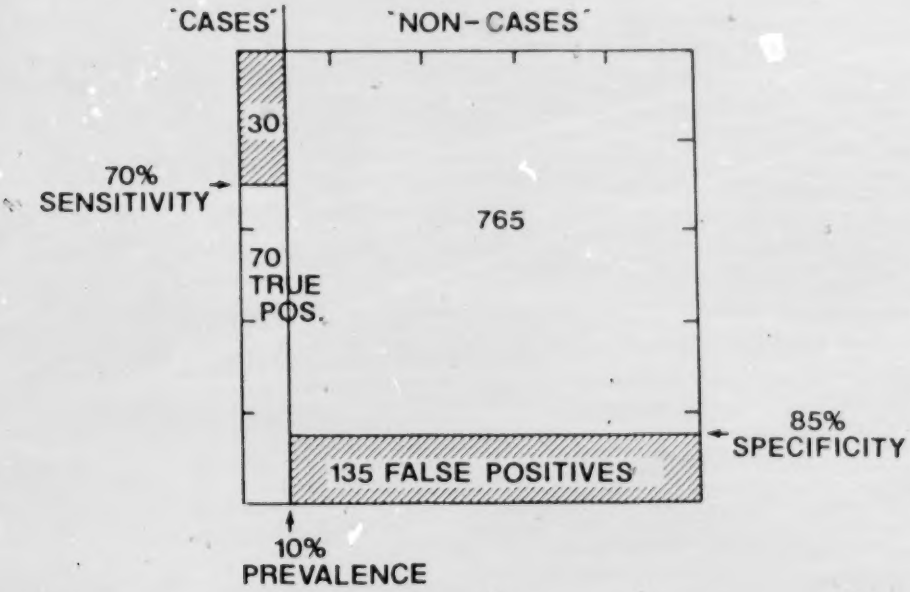

Figure III

SCREENING TEST RESULTS FOR 1000 CHILDREN:
HIGH PREVALENCE AND MEDIUM QUALITY SCREEN

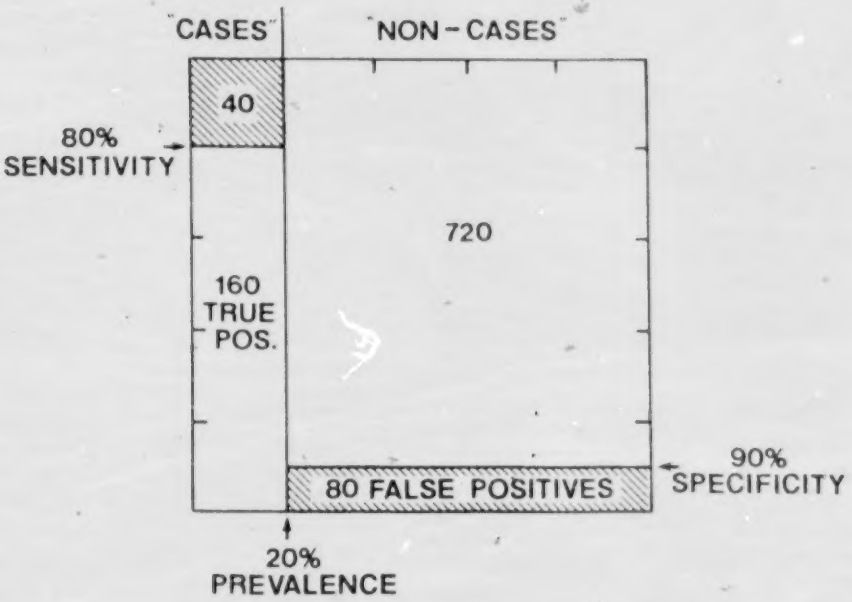

Figure IV

SCREENING TEST RESULTS FOR 1000 CHILDREN:
HIGH PREVALENCE AND VERY HIGH QUALITY SCREEN

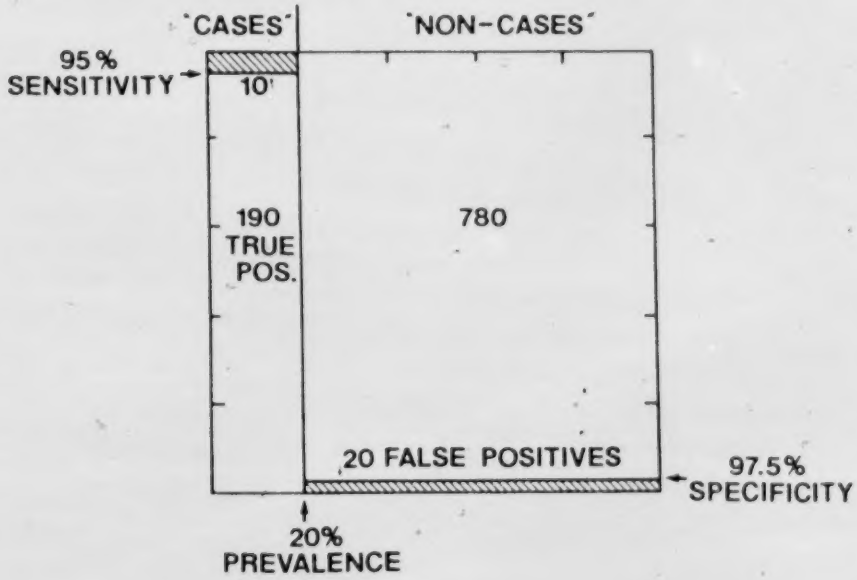

Table I

SCREENING TEST RESULTS FOR 1000 CHILDREN
UNDER DIFFERENT CONDITIONS OF
PREVALENCE AND QUALITY OF SCREEN

CONDITIONS:	high	medium	high	high	low
Prevalence	20%	10%	20%	20%	1%
Quality of Screen	medium	low	very high	high	high
Sensitivity	80%	70%	95%	90%	90%
Specifity	90%	85%	97.5%	95%	95%
SCREENING RESULTS:					
Total Children	1000	1000	1000	1000	1000
True Negatives	720	765	780	760	940.5
False Negatives	40	30	10	20	1.0
True Positives	160	70	190	180	9.0
False Positives	80	135	20	40	49.5
PROPORTION OF FALSE POSITIVES AMONG ALL TEST POSITIVES	33%	66%	10%	18%	85%